

GROUND WATER INVESTIGATION

San Mateo Creek Basin Uranium Legacy Site

TRONOX QUARTERLY MEETING

October 19, 2016

*Charge to
San Mateo Creek Basin
A6K6 T Fund*

Legacy of Uranium Mining in Northwestern New Mexico



- Uranium Mine
- ▲ Mill Location
- City or Town
- ▭ Uranium Sub-District
- ▭ Pueblo of Acoma
- ▭ Pueblo of Laguna
- ▭ Navajo Nation Chapter
- ▭ Navajo Nation Ownership
- ▭ San Mateo Basin
- ▭ NPL Site
- ▭ County
- Land Ownership for Tracts with Mines
 - ▭ Bureau of Land Management
 - ▭ Forest Service
 - ▭ Tribal Land
 - ▭ Private Land
 - ▭ State Land

Note:
The Land Ownership layer as displayed is not complete. The only areas displayed are those containing one or more mines.

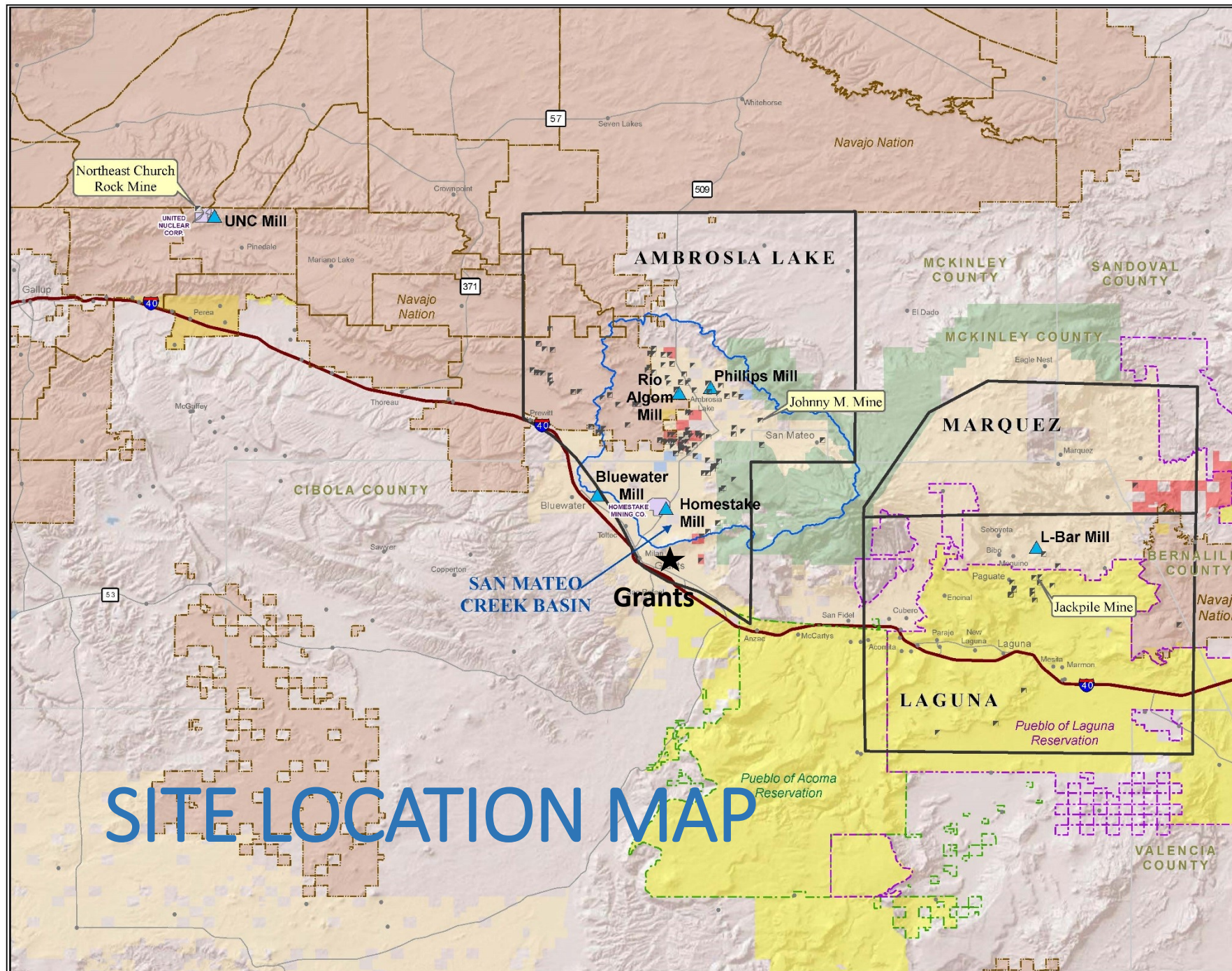
Sources:
MMD Legacy Uranium Mine Inventory: 12/2008.
EPA Region 6 National Priorities List (NPL), 5/2015.
Bureau of Land Management (BLM) Land Ownership.
Navajo Land Department 2016, Census Bureau 2000
TIGER/Line, ESRI World Shaded Relief.



EPA Region 6
Superfund
GIS Support
04/25/2016

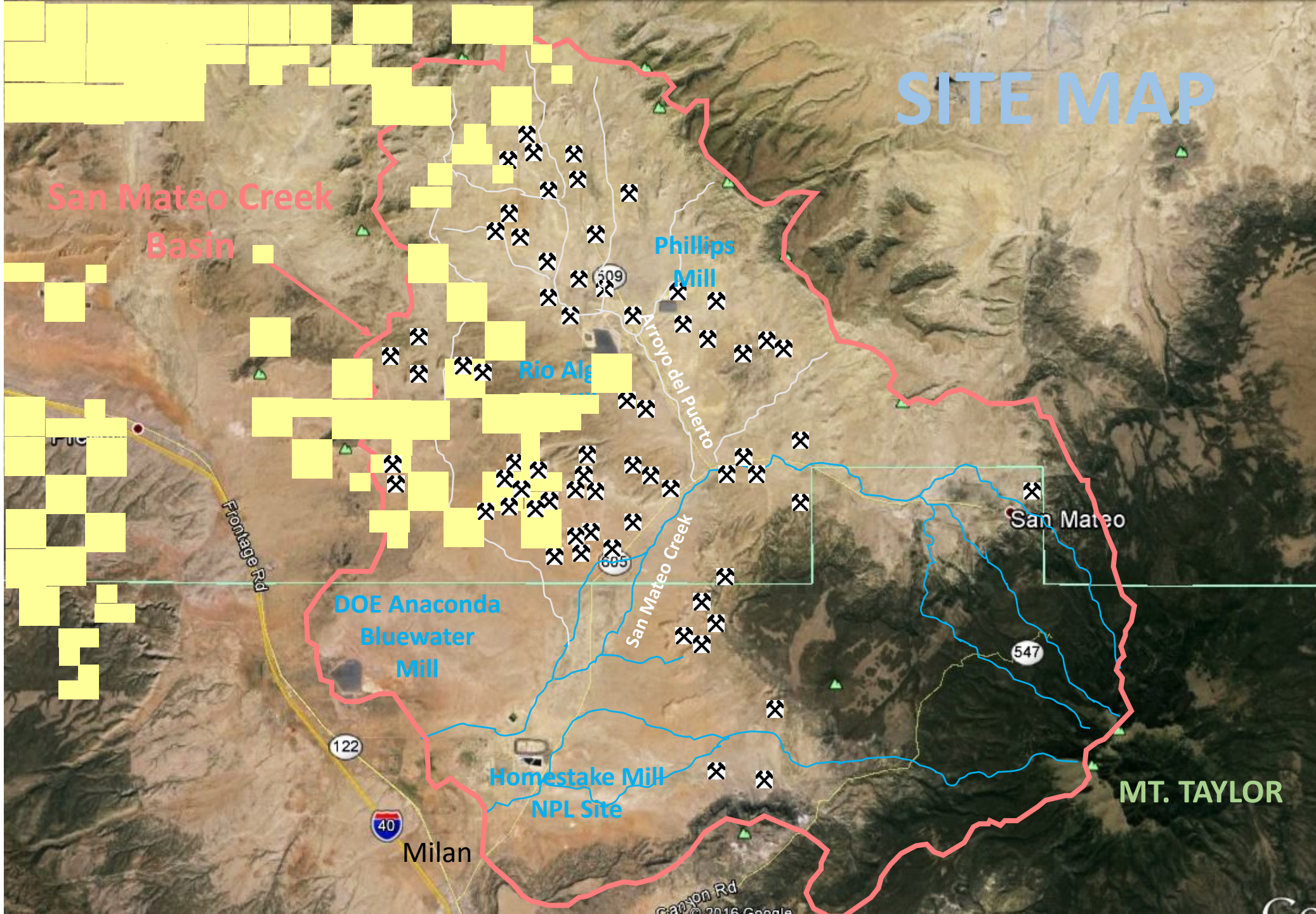


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SITE LOCATION MAP

SITE MAP



PROJECT OBJECTIVE

Investigate legacy uranium mining and milling impacts to ground water



MULTI-PHASED INVESTIGATION

Phase 1

*Alluvial Aquifer
San Mateo Creek Basin
2012 – 2016*



Phase 2

*Bedrock & Alluvial Aquifers
Tronox NAUM Ambrosia
Lake Impact Area
2015 – 2017*



Phase 3

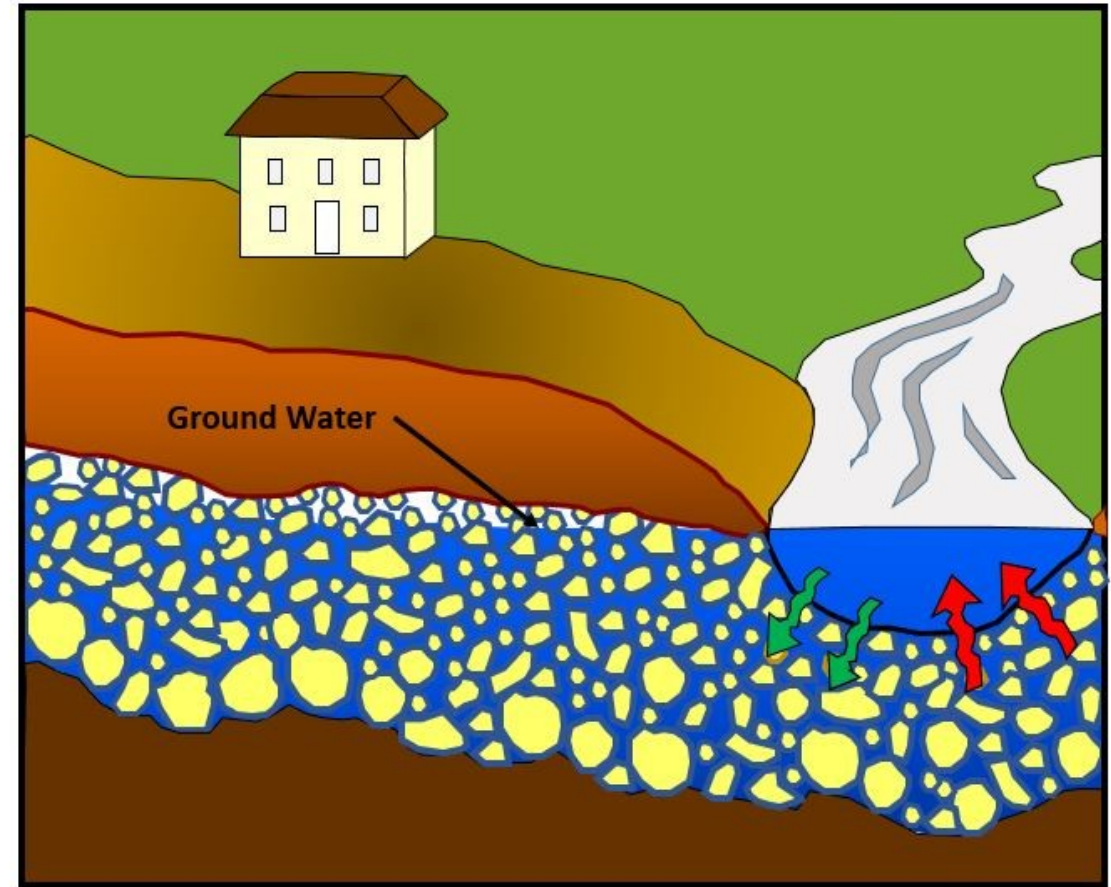
*Develop Conceptual Site
Model for Tronox NAUM
Impacts
2016 - 2018*



PRELIMINARY CONCEPTUAL SITE MODEL

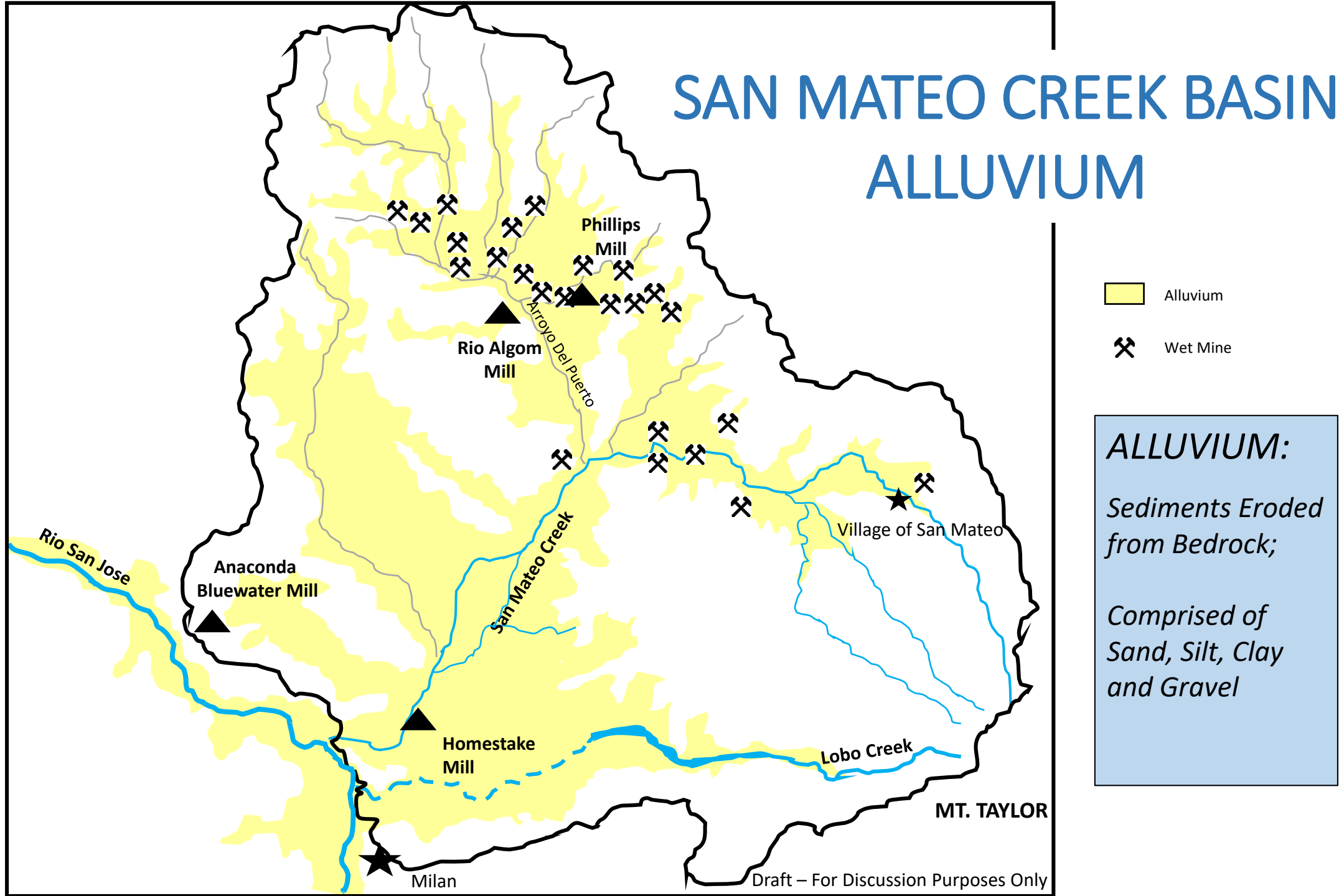
What We Needed to Understand

- Alluvial Aquifer
 - Where are the alluvial sediments?
 - Where is the ground water?
 - What is direction of flow?
- Bedrock Aquifers
 - What is the underlying bedrock geology?
 - What is the hydraulic relationship to the alluvium?

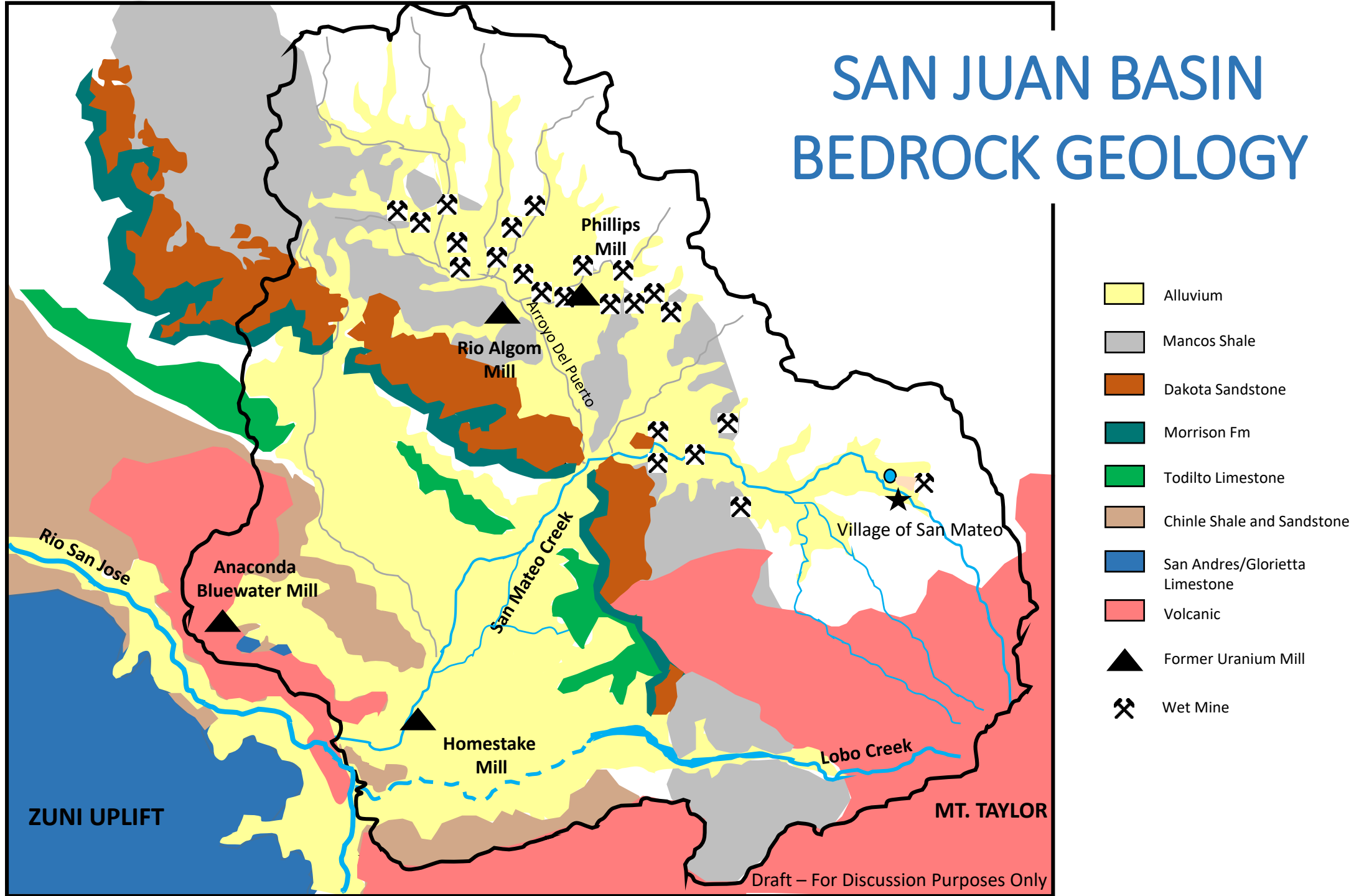


Modified from City of Las Cruces
Poster Display

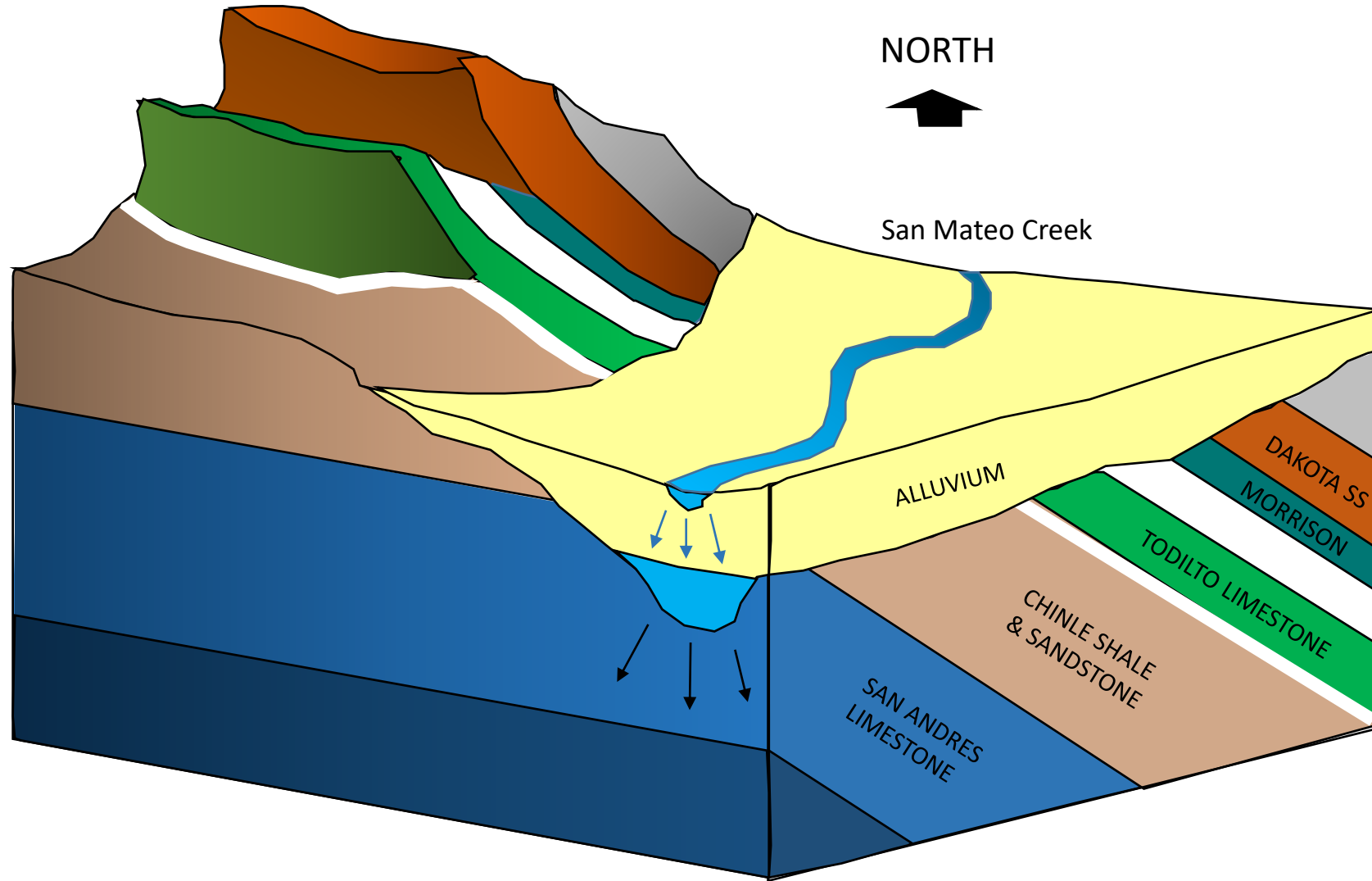
SAN MATEO CREEK BASIN ALLUVIUM



SAN JUAN BASIN BEDROCK GEOLOGY



CONCEPTUAL SITE MODEL



EXPOSED AND TILTED BEDROCK FORMATIONS

San Mateo Creek Basin



KEY COMPONENTS OF PHASE 1 GROUND WATER REPORT

- Historical studies on water quality and impacts
- Field investigation
- Conclusions

HISTORICAL STUDIES ON URANIUM MINING IMPACTS

- 1975 EPA study
 - Ground water contamination discovered
 - Sources – mine water discharge and tailing seepage
 - Perennial flows created in creeks/arroyos
- 1981 and 1986 New Mexico studies
 - Alluvial ground water exceeds standards
 - Mine discharge water rapidly infiltrates and saturates alluvium



1975 – Ambrosia Lake Area

SUMMARY OF HISTORIC MINE WATER DISCHARGE QUALITY

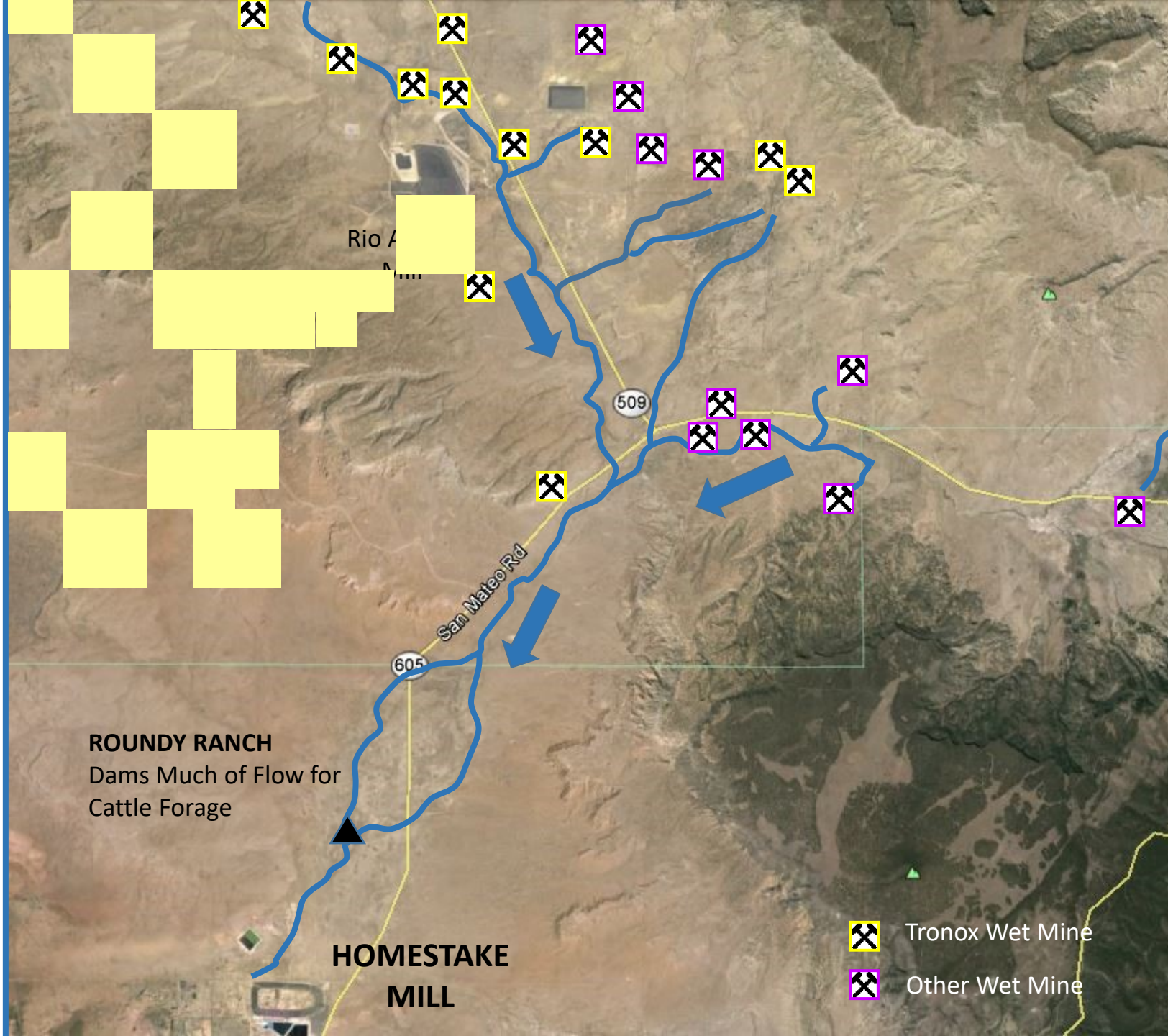
Comparison to Alluvial Background Water Quality

Contaminant	1981 Mine Water Discharge Ambrosia Lake Area	1981 Mine Water Discharge San Mateo Area	1978-80 San Mateo Creek Upland Alluvial GW (Background)
Gross Alpha (pCi/L)	580	1,100	2.5 – 15.0
Uranium (mg/L)	2.4	0.080	0.005 – 0.010
Selenium (mg/L)	0.410	0.040	0.005 – 0.005
Molybdenum (mg/L)	0.79	0.32	0.005 – 0.010
Chloride (mg/L)	90	10	3 – 8
Sulfate (mg/L)	837	205	5-20
Total Dissolved Solid (ppm)	1,690	520	125 – 300

New Mexico 1981 and 1986 Reports

MINE WATER DISCHARGE

Artificially
Created
Perennial Flows
Observed to
Reached
Homestake
Impoundment
(EPA 1980)



BORING/WELL LOCATION MAP

San Mateo Creek
Basin

- B** Background Boring/Well
- Dry Borehole
- New Monitoring Well
- Private Water Well
- Industry Monitoring Well

DOE Anaconda
Bluewater
Mill

Rio Algom
Mill

Phillips
Mill

Homestake Mill
NPL Site

San Mateo

MT. TAYLOR

Milan

Frontage Rd

Arroyo del Puerto
San Mateo Creek

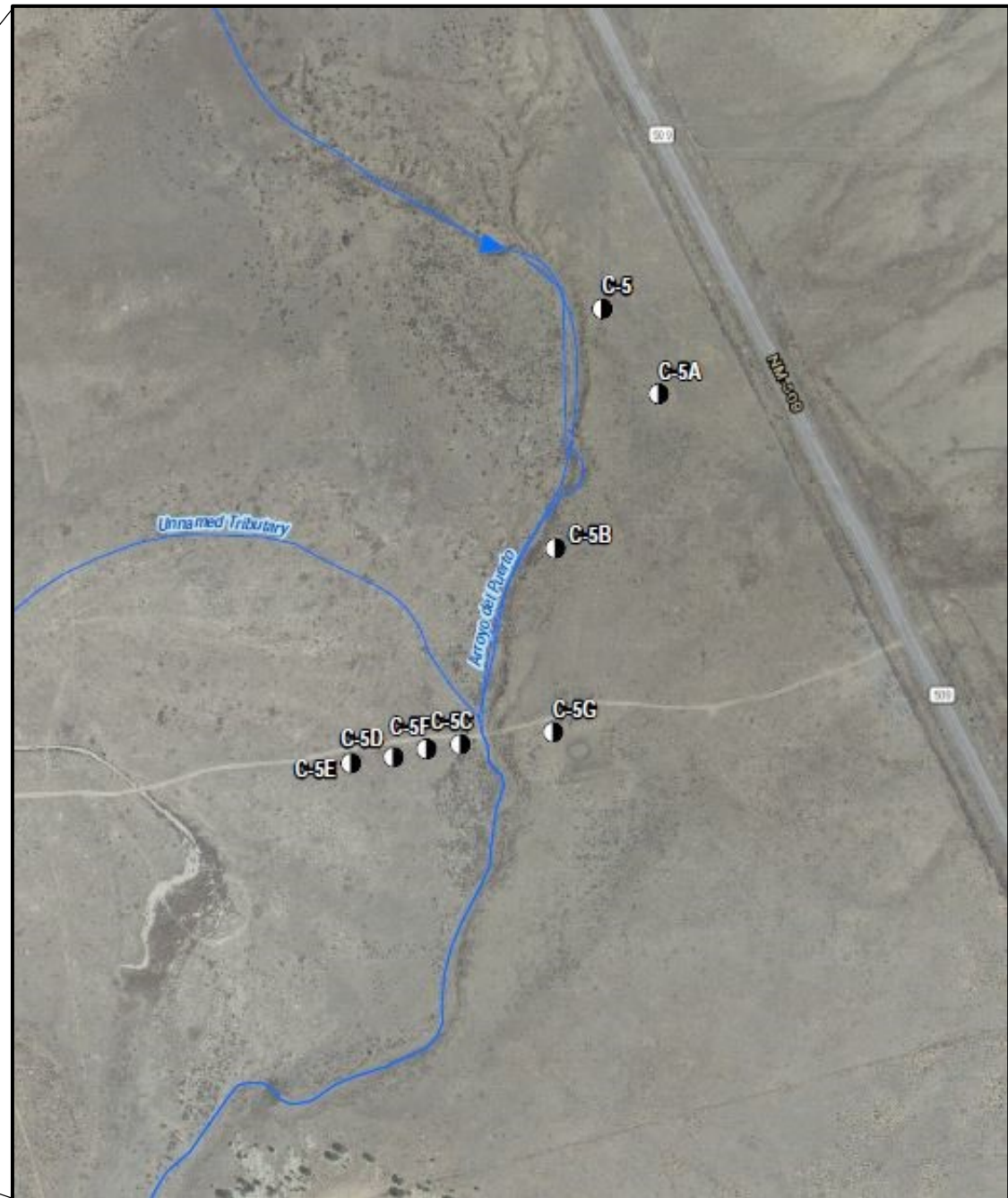
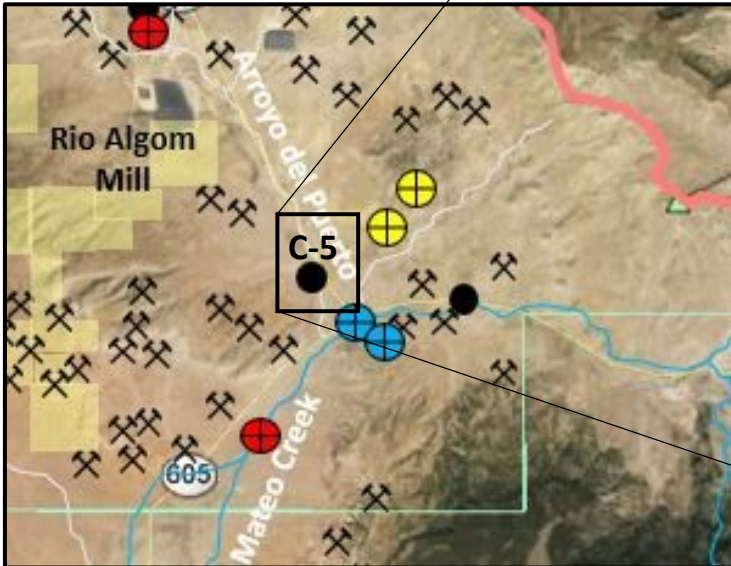
122

40

605

547

MULTIPLE BORINGS TO FIND ALLUVIAL WATER



SUMMARY OF CONCLUSIONS

Phase 1 Report

- Attempt to Characterize Alluvial Background had Mixed Results
 - Lack of Natural Saturation in Many Areas Investigated
- Alluvial Water Quality Varies Across Basin
 - Good quality upgradient of mines and mills
 - ✓ Meets standards
 - Poor quality downgradient of mines and mills
 - ✓ Exceeds standards
 - ✓ Similar to mine discharge water quality
- Mine Discharge Water Draining Through and Out of Alluvium

ALLUVIAL WATER QUALITY

- Alluvial ground water downgradient of legacy mines and mills exceed standards
- In comparison to background wells:
 - Greater than 3 times background
 - Uranium
 - Selenium
 - Total Dissolved Solids
 - Sulfate

Conclusion Nos. 4 and 6

- Alluvial water downgradient of Rio Algom Mill and Sec 35/Cliffside Mines of poorest quality
- Appear to be residual mine discharge water
- Draining into bedrock formations

ALLUVIAL WATER QUALITY MAP

San Mateo Creek
Basin

39

10,000

Phillips
Mill

3,600

Rio Algom
Mill

46

15

4,600

310

16

San Mateo

DOE Anaconda
Bluewater
Mill

110

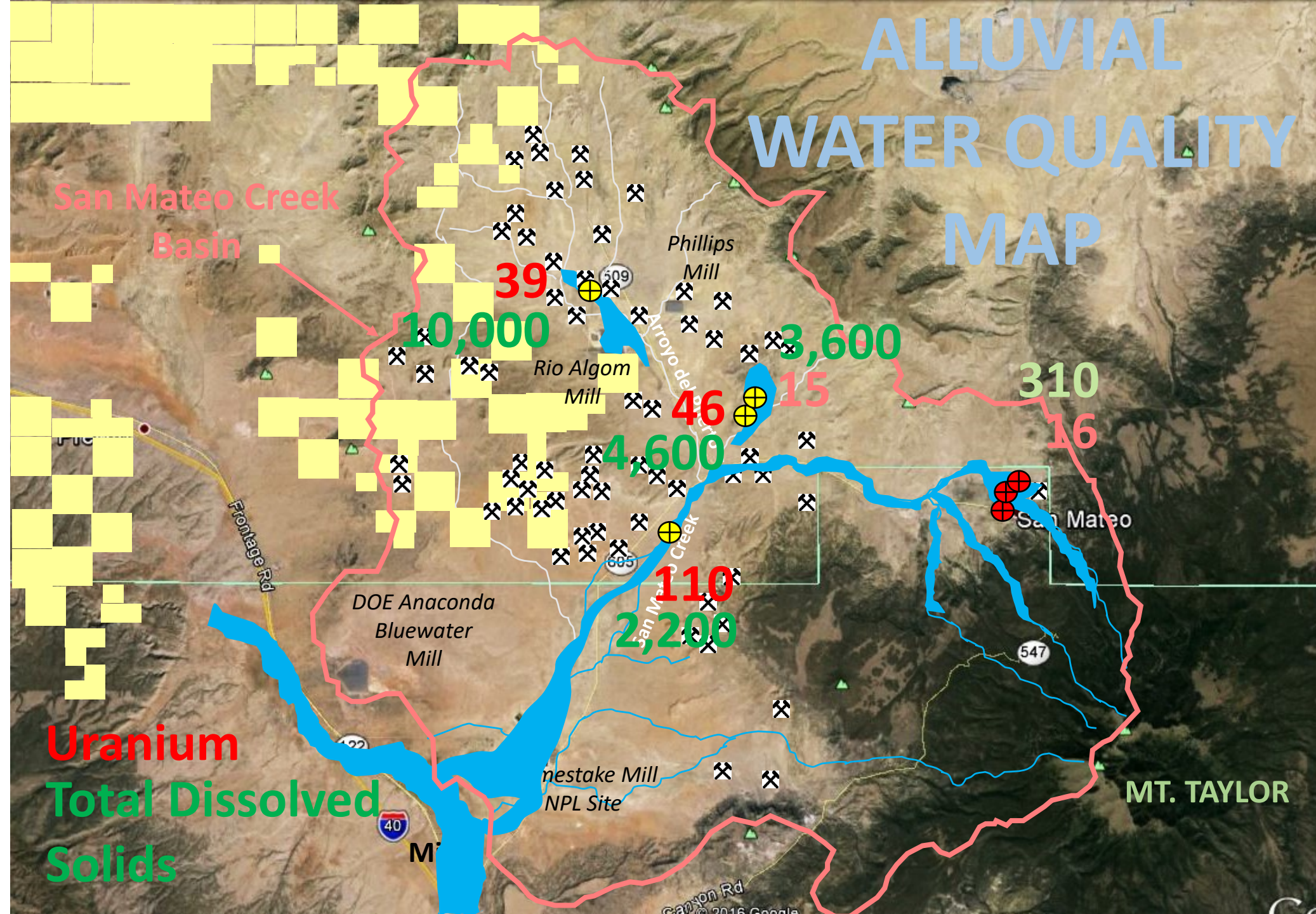
2,200

nestake Mill
NPL Site

MT. TAYLOR

Uranium

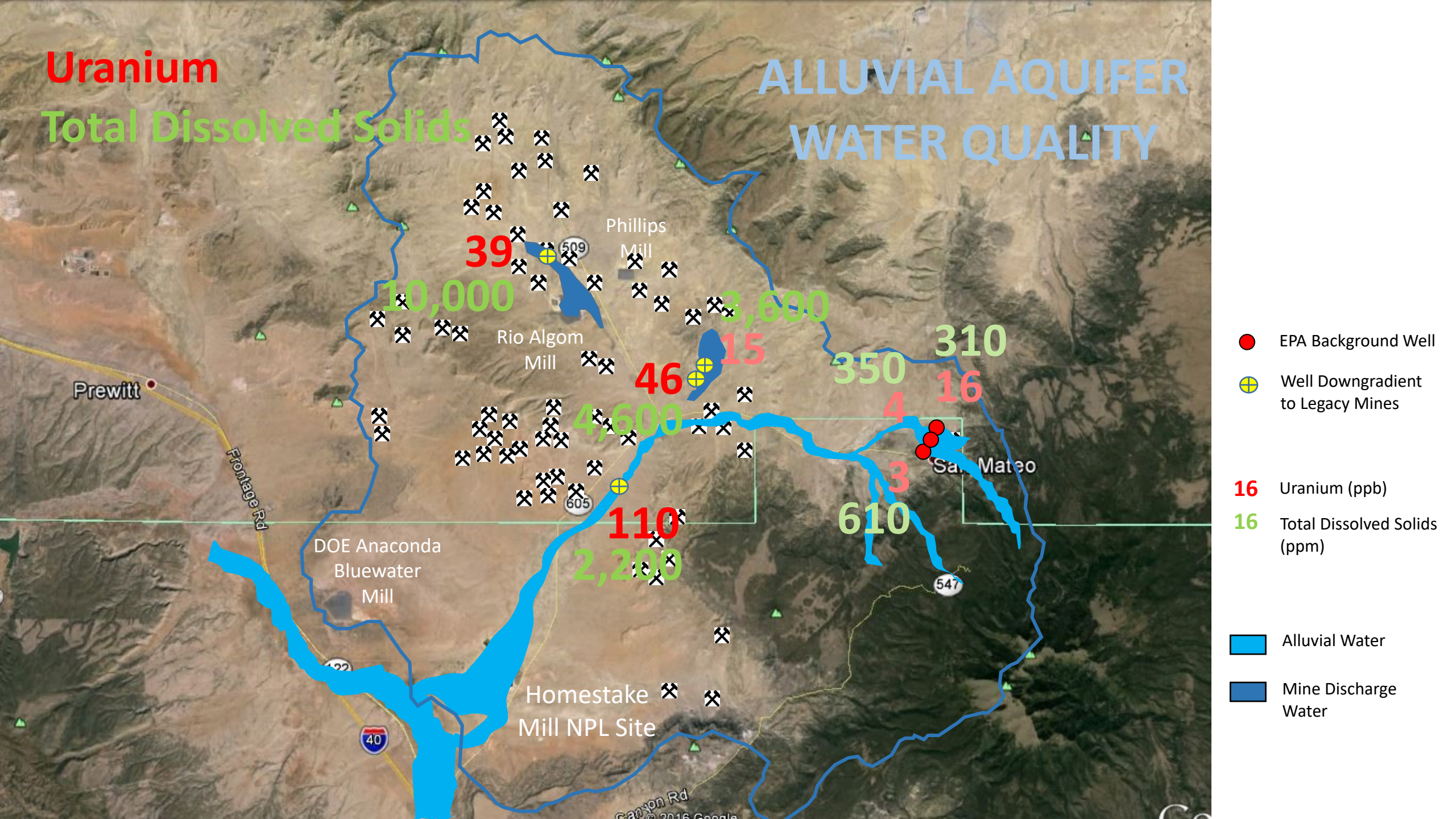
Total Dissolved
Solids



Uranium

Total Dissolved Solids

ALLUVIAL AQUIFER WATER QUALITY



● EPA Background Well

⊕ Well Downgradient to Legacy Mines

16 Uranium (ppb)

16 Total Dissolved Solids (ppm)

□ Alluvial Water

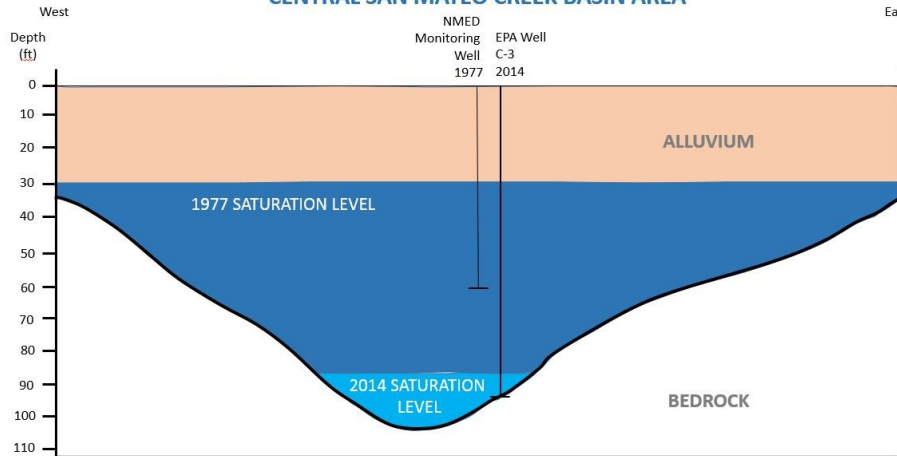
□ Mine Discharge Water

Conclusion No. 5

- Mine water discharges resulted in saturation and desaturation of Alluvium on massive scale
- Water levels in central part of basin raised and dropped over 50 feet
- Drain down not observed at Homestake

CROSS SECTION A - A'

CENTRAL SAN MATEO CREEK BASIN AREA

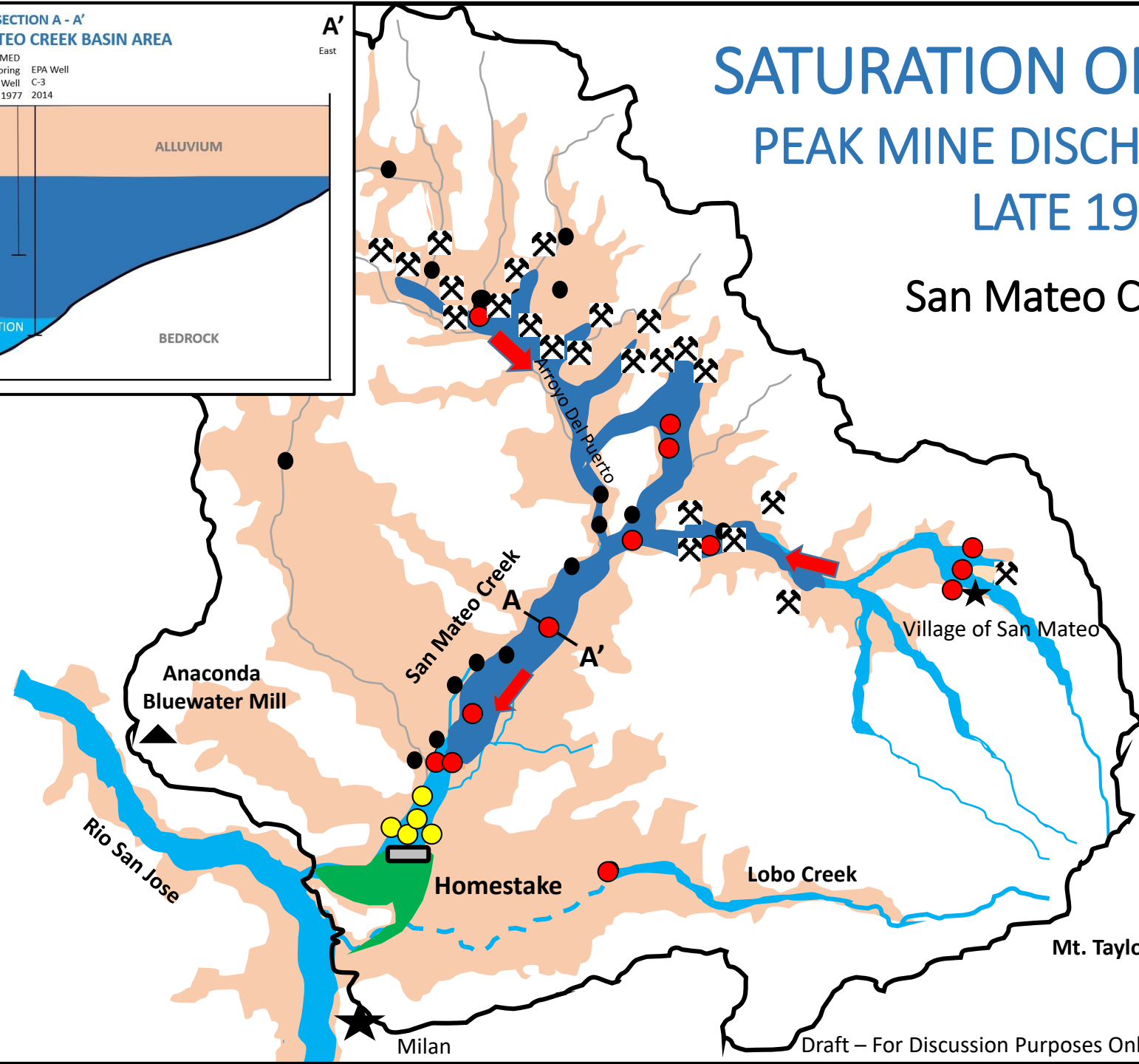


SATURATION OF ALLUVIUM

PEAK MINE DISCHARGE PERIOD

LATE 1970S

San Mateo Creek Basin

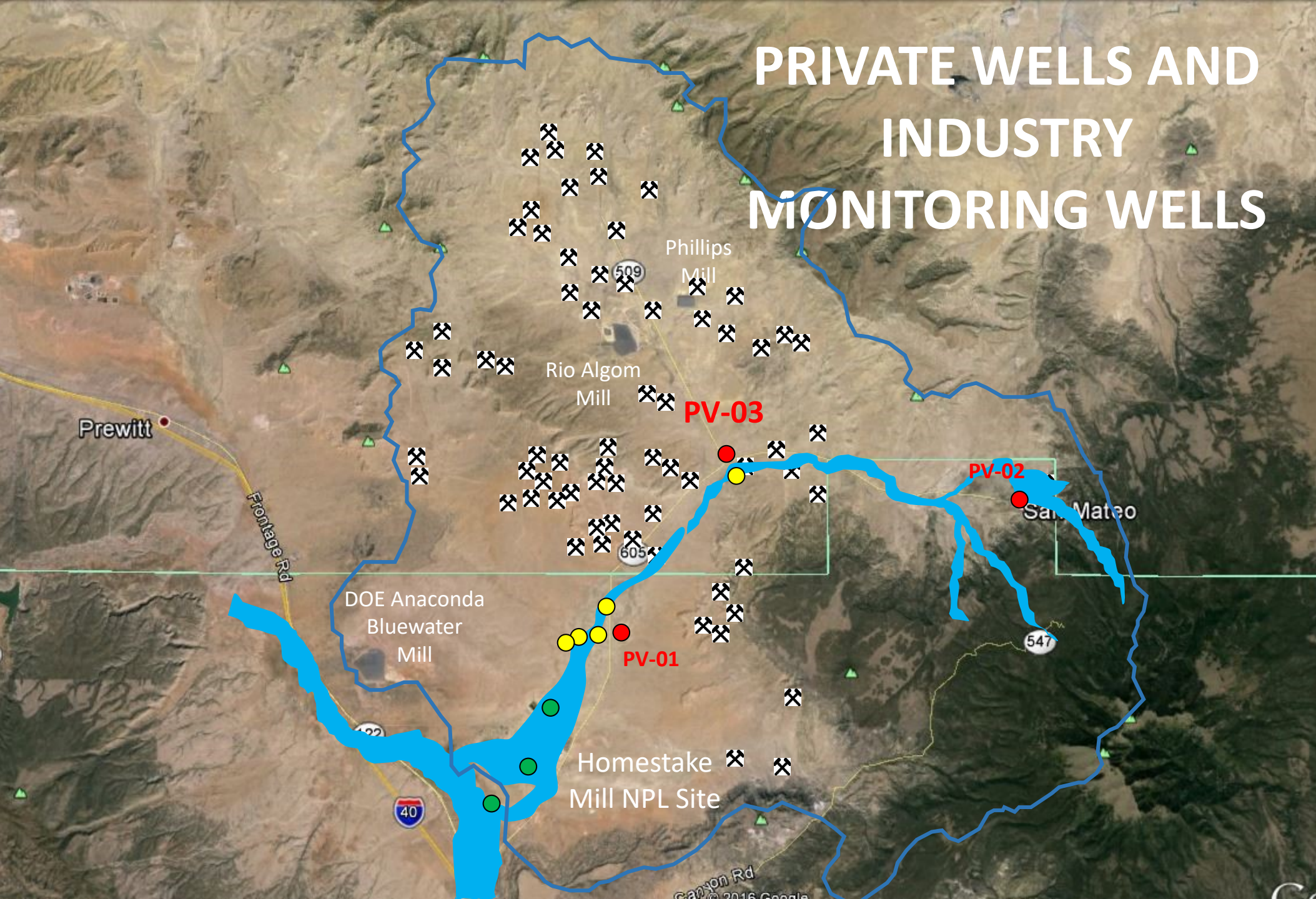


- Alluvial Aquifer
- Tailing Seepage Impacts
- Mine Discharge Water
- Alluvium
- Alluvial Monitoring Well
- Homestake Background Alluvial Monitoring Well
- Alluvial Dry Borehole
- Wet Mine
- Ground Water Flow

Conclusion No. 7

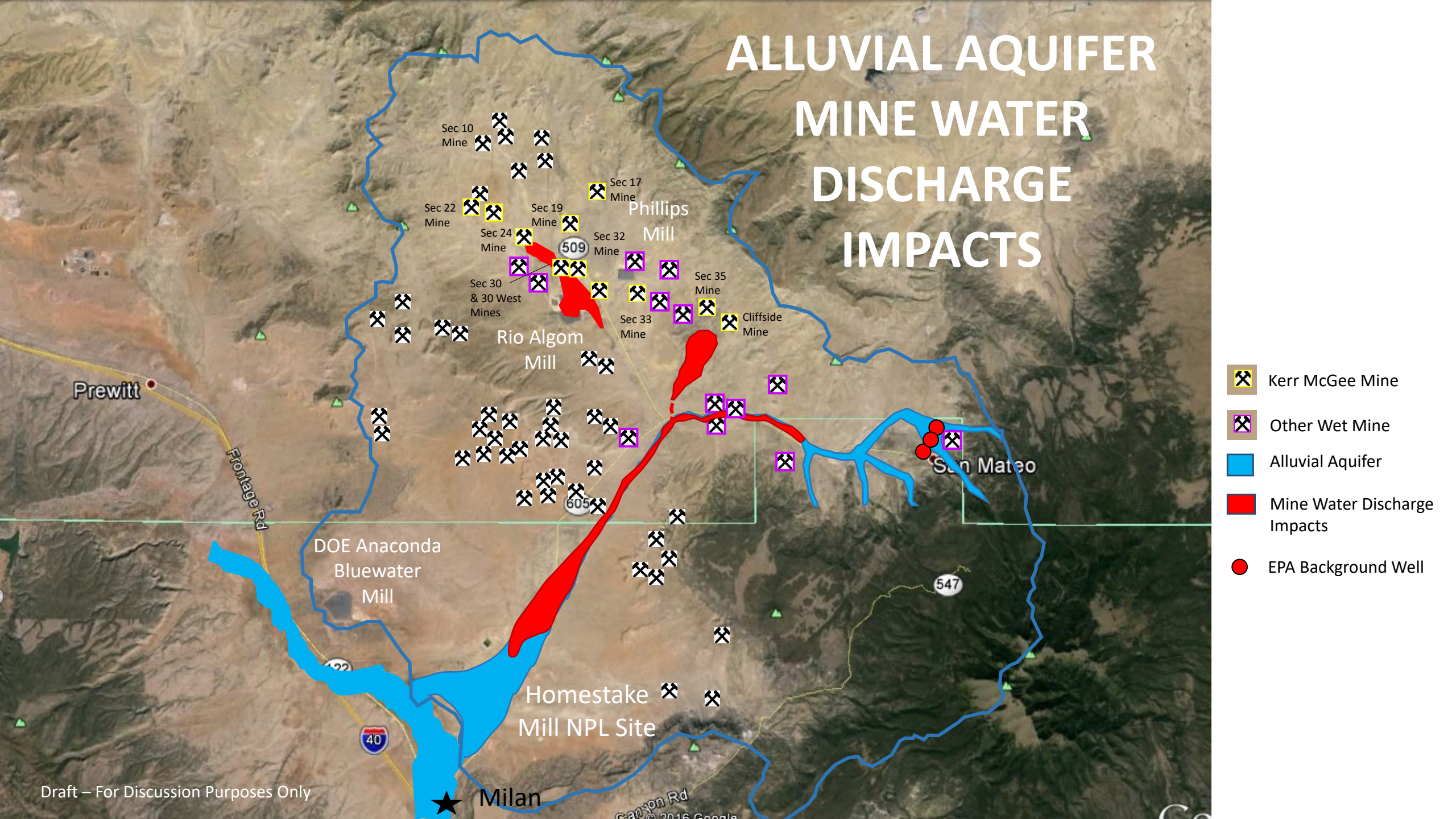
- 12 private wells and other industry monitoring wells exceeded standards
- Only 3 of 12 wells used for drinking water supply
- Only 1 of the 3 exceeded EPA MCLs or NM drinking water standards (PV-03)
- Point of Use Treatment Systems installed by Removal at home for PV-03

PRIVATE WELLS AND INDUSTRY MONITORING WELLS



- Private Well
- Other Private Well (Livestock Watering or industry Monitoring Well)
- Other industry Monitoring Well San Andres/Glorieta

ALLUVIAL AQUIFER MINE WATER DISCHARGE IMPACTS



STATUS OF PHASE 2 INVESTIGATION

- Drilling/Sampling – 2015 to Early 2016
 - Focus on Dakota Sandstone – Ambrosia Lake Area
 - Alluvium – Central Basin
- Analytical Results – Summer 2016
- Data evaluation and interpretation – Ongoing
- Draft report preparation - Ongoing

ONGOING WORK

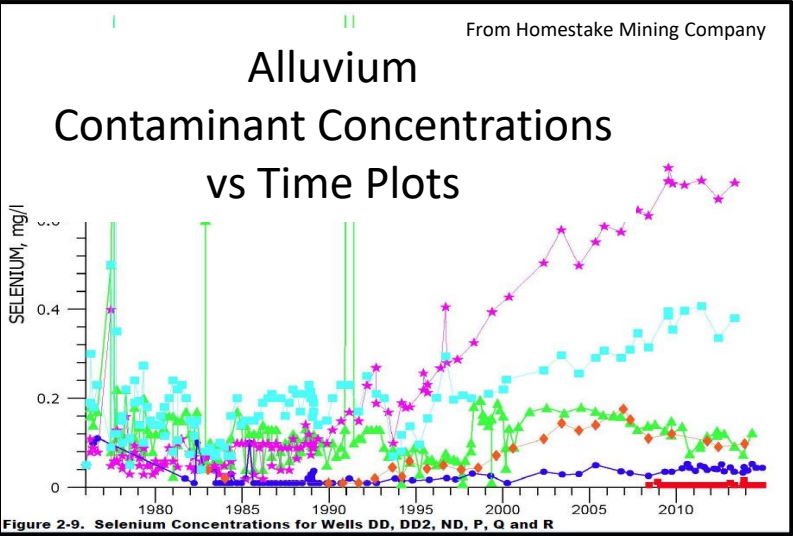
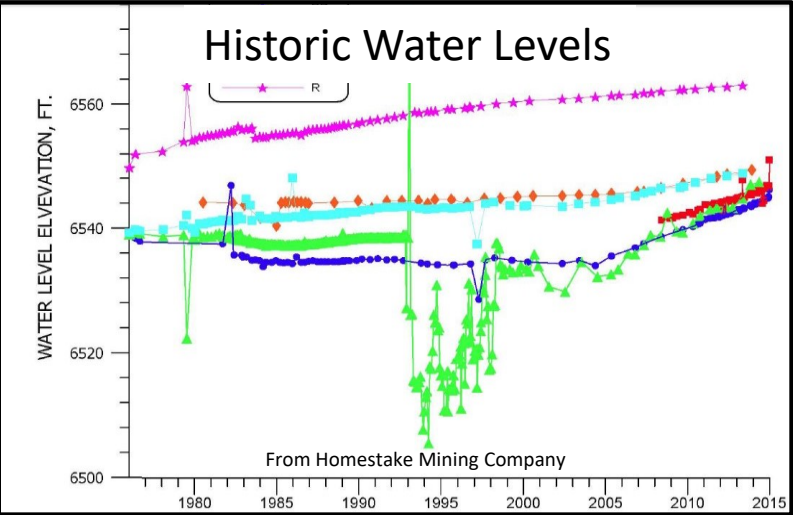


Figure 2-9. Selenium Concentrations for Wells DD, DD2, ND, P, Q and R

1

2

3

4

5

6

7

8

9

10

11

12

13

14

15

16

17

18

19

Section 35 Mine, Ambrosia Lake, NM

Mass of Uranium, Molybdenum, & Selenium discharged from 1960 to 1976 before NPDES treatment

LOWER MINE WATER DISCHARGE RATE

Discharge Period

Discharge Rate GPM

minutes per day

million gallons per day (MGD)

AVG COC concentration in mine effluent (MG/L)

Formula: lbs/day = dose X flow x 8.34 lb/gal

AVG POUNDS PER DAY (lbs/day)

PER YEAR

DISCHARGED

DISCHARGED

URANIUM

1960-1976

850

1,440

1.22

5.25

(5.25 MG/L) X (1.22 MGD) X 8.34 lb/gal

53.59

19561.39

312982.19

156.49

MOLYBDENUM

1960-1976

850

1,440

1.22

1.91

(1.91 MG/L) X (1.22 MGD) X 8.34 lb/gal

19.50

7116.62

113865.90

56.93

SELENIUM

1960-1976

850

1,440

1.22

0.02

(0.02 MG/L) X (1.22 MGD) X 8.34 lb/gal

0.20

74.52

1192.31

0.60

HIGHER MINE WATER DISCHARGE RATE

Discharge Period

Discharge Rate GPM

minutes per day

million gallons per day (MGD)

AVG COC concentration in mine effluent (MG/L)

Formula: lbs/day = dose X flow x 8.34 lb/gal

AVG POUNDS PER DAY (lbs/day)

AVG POUNDS PER YEAR

16 YEAR TOTAL POUNDS DISCHARGED

16 YEAR TOTAL TONS DISCHARGED

URANIUM

1960-1976

2,618

1,440

3.77

5.25

(5.25 MG/L) X (3.77 MGD) X 8.34 lb/gal

165.07

60249.07

963985.13

481.99

MOLYBDENUM

1960-1976

2,618

1,440

3.77

1.91

(1.91 MG/L) X (3.77 MGD) X 8.34 lb/gal

60.05

21919.19

350706.97

175.35

SELENIUM

1960-1976

2,618

1,440

3.77

0.02

(0.02 MG/L) X (3.77 MGD) X 8.34 lb/gal

0.63

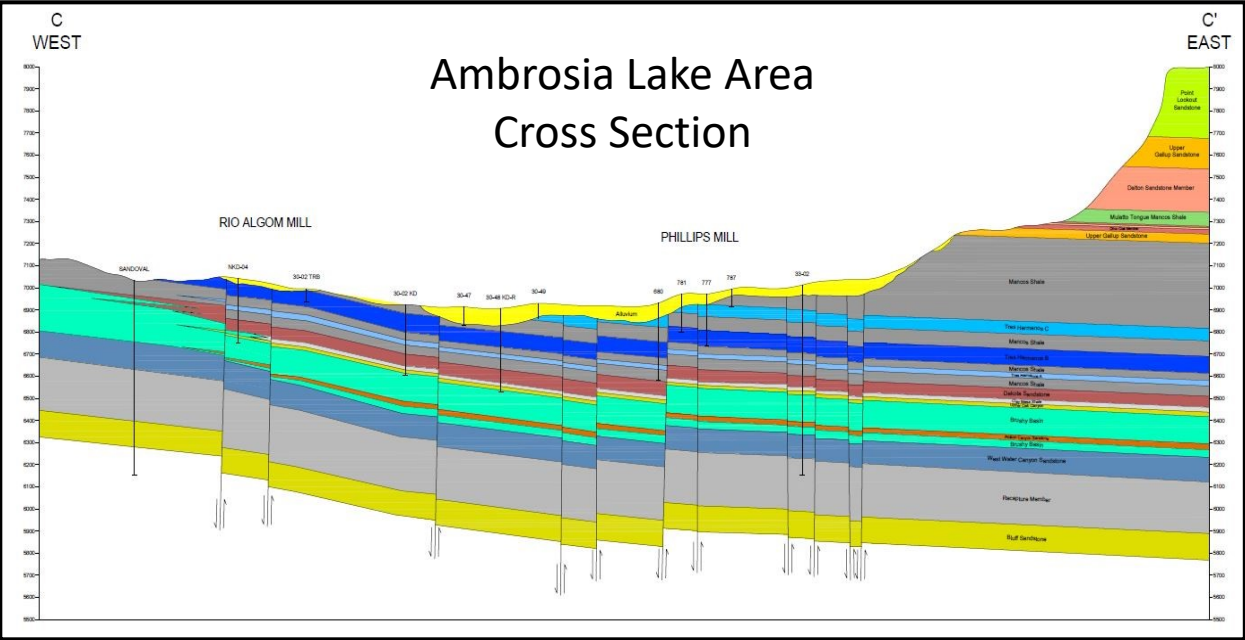
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3672.32

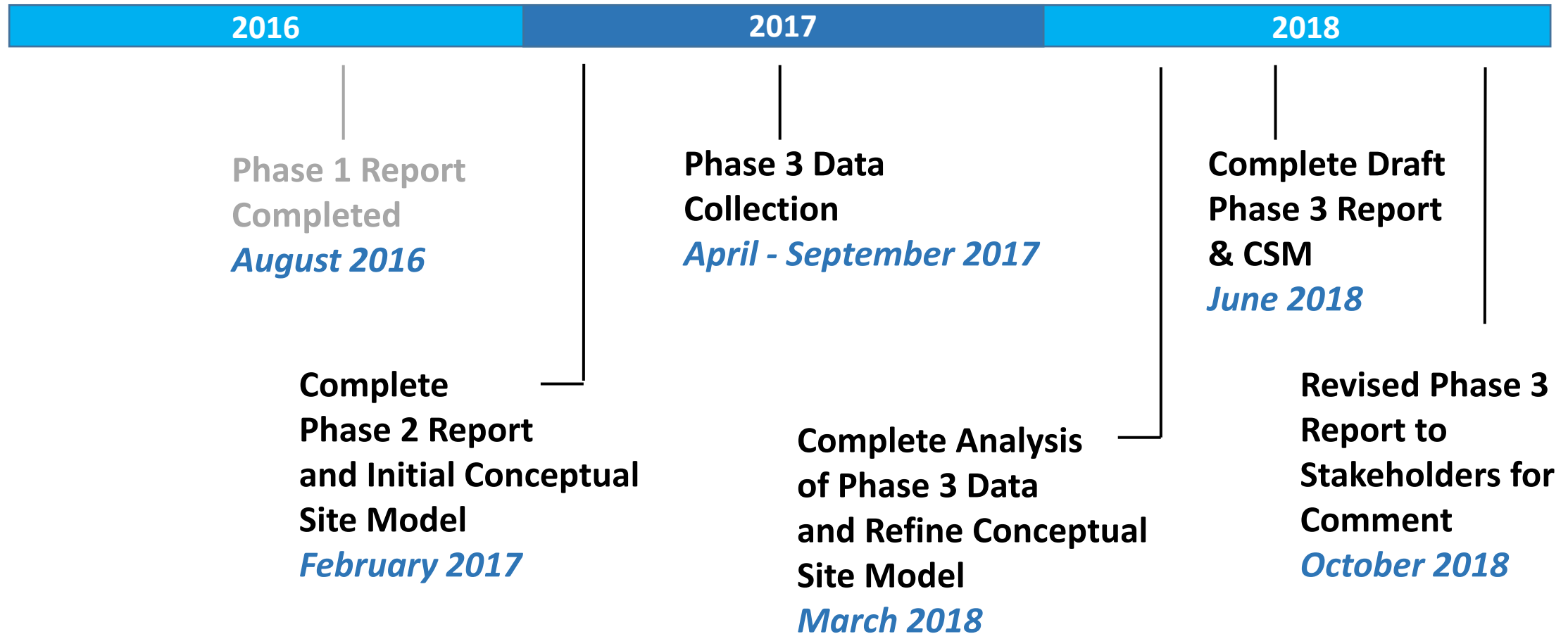
1.84

Contaminant Mass Loadings

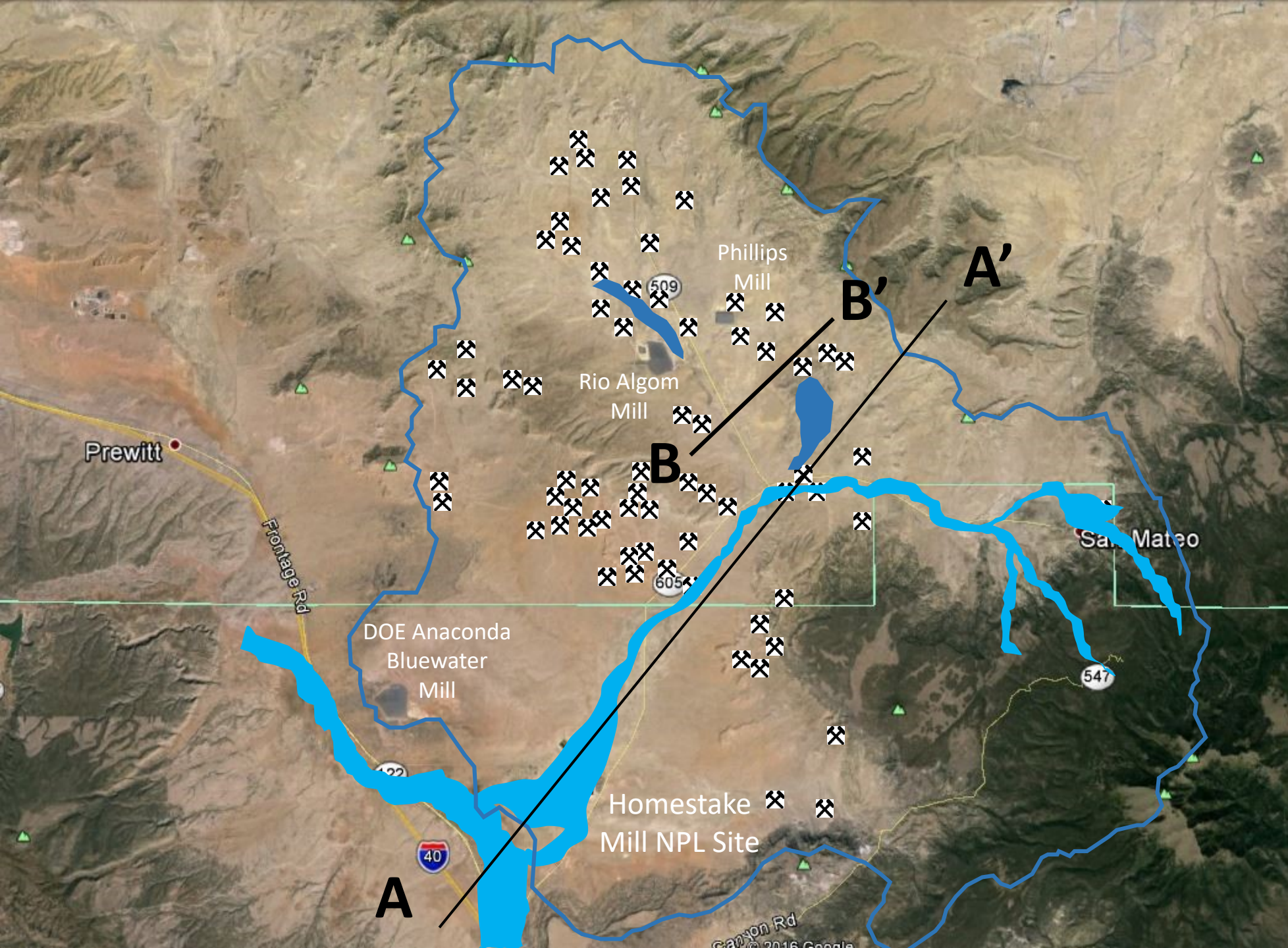
from Mines



PLANNED ACTIVITIES FOR GROUND WATER INVESTIGATION



Cross Sections A-A' and B-B'



Phase I Report Roll-Out

- August 25 – Brief SF Director
- By September 1 – Send to Federal Partners (R9, NMED, MMD, DOE, NRC, BLM, DOI, USFS, USGS)
- September 16 – Public Release
 - Website
 - Tribal Contacts
 - DVDs as Requested
- October 19/20 – Tronox Quarterly Presentation (Navajo, R9, State)
- Week of November 14 – Public Meetings

Other Slides